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ABSTRACT

The Technical and Vocational Education Initiative (TVEI) pilot projects (1982-1987) in the United Kingdom produced many changes in school curricula, timetabled subjects, and enrollment in technology-related courses. The integration of technology into the curriculum within the TVEI pilot follows four principal patterns: independent projects that stand alone from a particular subject or examination, structured courses in an aspect of technology leading to a recognized public examination, collaborative links between subjects, and technological enrichment of individual subjects. National criteria have been published for 20 subjects, including a set of craft, design, and technology (CDT) courses. The emergence of these new courses has inevitably affected the distribution of curriculum time, with more time now being spent on computing and information technology and less on such subjects as home economics, creative and aesthetic arts, and sciences. The number of TVEI students following craft and design courses has decreased, whereas the number of those pursuing technology has increased. The changes resulting from the TVEI initiatives have many implications for further education in such areas as pupils' prior experience, demographic and market trends, cooperation among institutions, and changes in science education. (Appendixes include a comparison of CDT courses, and enrollment data for TVEI versus non-TVEI students.) (MN)

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School Technology is Changing: Implications for Schools and Colleges

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A paper from
Secondary Science Curriculum Review
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School Technology is Changing: Implications for Schools and Further Education

Background

This paper highlights changes in school curricula, timetabled subjects, examinations and student numbers in the area of technology during the period of the Technical and Vocational Education Initiative (TVEI) pilot projects (1982 - 1987). It should also stimulate awareness in and response by further education (FE) institutions to the changing nature of technology in school education.

The pilot phase of TVEI has accelerated change within secondary schools. The TVEI Unit's paper "Technology for TVEI"¹ adopts a broad perspective on technology in the statement :-

"Technology is the disciplined process of using scientific material and human resources to achieve human purpose"

"Technology for TVEI" highlights some of the educational aims of technology in the development of:-

- a) technological awareness
- b) practical capability
- c) the pupil's resource base (practical skills, knowledge, intellectual skills and other personal qualities).

Technology in the School Curriculum

At this stage in the evolution of technology education there are considerable changes which may affect perceptions of and attitudes to this area of the school curriculum from the National Curriculum Design and Technology Working Group recommendations which are imminent, to the consolidation of GCSE as a means of assessment.

With this in mind, it may be helpful to look at part of these evolutionary processes, particularly in a TVEI context, their effects and consequent implications.

The integration of technology into the curriculum within the TVEI pilot follows four principal patterns¹:-

- 1) independent projects which stand alone from a particular subject or examination.
- 2) structured courses in an aspect of technology leading to a recognised public examination.
- 3) collaborative links between subjects.
- 4) technological enrichment of individual subjects.

Technology education in secondary schools' curricula might be considered to be diverse. Therefore, FE institutions should endeavour to gain an understanding of subjects and curricular patterns which claim to provide a technological experience in their feeder institutions.

The Secondary Examinations Council (SEC) has published GCSE national criteria for twenty subjects, including "Craft, Design and Technology" (CDT)². From the CDT Criteria (see last page) and "Technology for TVEI", it is clear that technology has many interpretations. Therefore, it is understandably difficult, for those in schools and FE, to be sure about the nature of technology within programmes of study, the assessment of such programmes of study and the capability of students engaged in them.

The identification of technological activity and its associated skills and knowledge, and the description of

- a) programmes of study in secondary education,
- b) titles of examinations indicated in the subject-specific national criteria, and
- c) other examinations

can, potentially, compound the possible confusion.

Under the GCSE criteria for CDT, three *Mode 1* courses for examination are supported by SEC, namely, "CDT: Design and Realisation", "CDT: Technology" and "CDT: Design and Communication". It is stated in the introduction to the criteria that,

"The aims of any course in Craft, Design and Technology should reflect the complex abilities required to exercise control over the man-made environment but the common core of activity can be identified as designing and communicating, making, testing and evaluating. Although these skills and the related value judgements are common to all courses in Craft, Design and Technology, the "knowledge" content of differing courses will vary. To make provision for the range of activities it is necessary to offer examinations to cover particular areas of study which will have in common the central aims of Craft, Design and Technology as a subject."

Table 1 provides an analysis of the nature of examination group syllabuses which meet SEC CDT subject-specific criteria. Closer examination reveals anomalies across the examination groups for the same subject title, e.g. "CDT: Design and Realisation" but that there are also many circumstances of similarity across all CDT subjects. Those with 75% or more similarity are indicated in the last column.

Table 1 is drawn from the published material of the examination groups³. Each syllabus has been examined for skills and knowledge components. Subsequently, these have been classified under three headings:-

- specific reference,
- general comment, or
- little or no reference.

Table 1. Analysis of GCSE CDT syllabuses

	NEA	LEAG	WJEC	MEG	SEG	
Subject Content	Design and Realisation Technology Design and Communication	Design and Realisation Technology Design and Communication	Design and Realisation Technology Design and Communication	Design and Realisation Technology Design and Communication	Design and Realisation Technology Design and Communication	75%+ Similarity
Skills						
Design						
- problem solving	■	□	□	■	□	✓
- synthesis	■	■	■	■	■	✓
- mathematical modelling	□	■	■	■	■	✓
- analysis	■	■	■	■	■	✓
- specification	■	■	■	■	■	✓
- observation	■	■	■	■	■	✓
- planning	■	■	■	■	■	✓
Making						
- prototyping and model making	■	■	■	■	■	✓
- assembly and fitting	■	■	■	■	■	✓
- manipulation of tools/materials	■	■	■	■	■	✓
Communication						
- verbal/written	■	■	■	■	■	✓
- numerical	■	■	■	■	■	✓
- graphical	■	■	■	■	■	✓
Knowledge						
- materials	■	■	■	■	■	✓
- workshop practice	■	■	■	■	■	✓
- structures	■ M	■	■	■ M	■	✓
- energy	■	■	■	■	■	✓
- motion and mechanisms	■ M	■ M	■	■	■	✓
- electricity	■	■	■	■	■	✓
- control	■	■	■	■	■	✓
- computing	■ M	■ M	■	■	■	✓
- ergonomics	■	■	■	■	■	✓
- aesthetics	■	■	■	■	■	✓
- safety	■	■	■	■	■	✓
- technology and society	■	■	■	■	■	✓

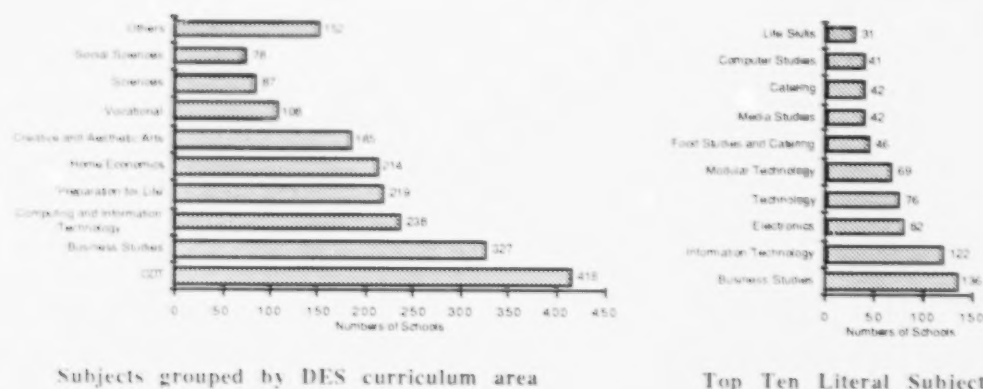
Specific references are shown thus: ■
 General references are shown thus: □
 Little or no references are left blank
 Specific modules of study are indicated: M

It is evident from the table that technology, as defined by these skills and knowledge elements, is not confined to "CDT: Technology" or other CDT syllabuses. Since technology can be delivered through courses other than CDT, it is important for FE institutions to ascertain incoming students' technological experience.

The curriculum database run by TVEI has been monitoring curriculum changes resulting from the TVEI pilot programmes⁴. The emergence of "new" or "enhanced" subjects has been used as an indication of developments within the curriculum. The former have been introduced as a result of TVEI while the latter are existing subjects which have changed with the advent of TVEI.

Figure 1 indicates the number of schools introducing "new" subjects. These are listed in terms of curriculum areas (on the left) and the top ten literal subject titles (on the right). The number of schools in the sample is 360, drawn from all rounds of the TVEI pilot programme in 1986/87.

Figure 1. Number of schools introducing new subjects



It should be noted that the curriculum area showing the greatest increase is CDT. However, the largest growth, as registered in the top ten literal subject titles, does not include CDT as such.

The emergence of new courses has inevitably affected other programmes of work in schools, and in particular, the distribution of curriculum time. Table 2 indicates subject fields which gained and lost curriculum time with the advent of TVEI pilot projects.

Table 2. Average percentage curriculum time for subjects, pre- and post- advent of TVEI

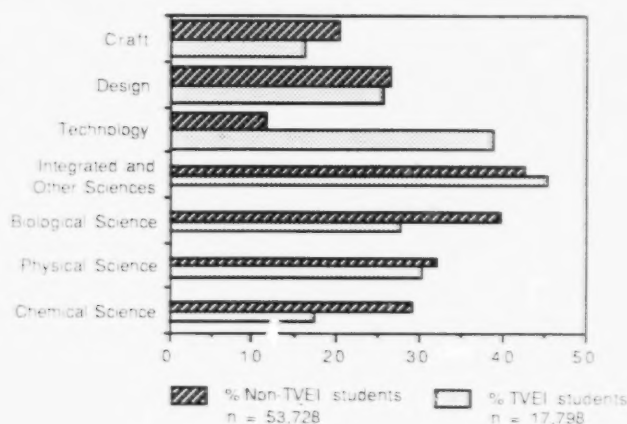
Subjects	pre-TVEI	TVEI
CDT Technology	0.84	5.07
Computing and Information Technology	1.98	5.56
Business Studies	0.29	3.08
CDT Design & Related Studies	1.47	2.39
Mathematics	13.25	12.92
Home Economics	4.61	3.48
Creative & Aesthetic Arts	6.16	4.94
CDT Craft	4.48	2.82
Sciences	15.44	12.05
Others	51.47	47.69

While these changes in curriculum time have implications for resources, accommodation, staffing and timetabling, in schools, it is the changing numbers of students taking examination subjects which may provide a more useful indication of the student population entering FE. Figure 2 shows the percentage of students, TVEI and non-TVEI, engaged in CDT-based subjects. The sciences have been provided as a benchmark.

Figure 2 also shows that, in percentage population terms, there is a decrease in TVEI students following craft and design courses and an increase in those pursuing technology.

It would be naïve to expect non-TVEI students to follow precisely the same pattern as TVEI students, in the extension phase of TVEI, for many reasons, e.g. resourcing and other curriculum changes. It may, however, be reasonable to assume that a change from the non-TVEI to the TVEI position (in the pilot programme) may occur with the extension phase of TVEI, which will encompass all students.

Figure 2. Percentage non-TVEI/TVEI population taking CDT-based subjects



The breakdown of this technology component is given in Appendix 2 which indicates the most popular programmes of study in the technology field in terms of student numbers. It is interesting to note the change in nature of these popular technology programmes away from the stereotyped and more traditional CDT courses.

Implications for Schools and Further Education

1. FE institutions should seek to determine pupils' prior experience, value it, and build on this, particularly in terms of:-
 - a) continuity
 - b) coherence
 - c) progression
 - d) relevance
2. a) This document has highlighted CDT as a growth curriculum area, but it is clear that contributions other than CDT should be considered when evaluating students' experience.
- b) Even within CDT, experience may be provided by a variety of subject titles. Therefore FE institutions should familiarise themselves with the content of new syllabuses.
3. FE institutions should seek to provide a flexible response to meet demographic and market trends.

This will require changes to:-

- a) induction courses
 - b) main course structure
 - c) INSET (see below)
 - d) marketing strategies, including equal opportunities.
4. Schools and FE institutions should seek greater opportunities for collaboration and co-operation, possibly through joint INSET programmes.
 5. This paper has indicated changes in course structure which require revised teaching styles in schools. Therefore FE institutions should adapt and modify existing styles to address the expectation of students.
 6. FE institutions should seek to be aware of parallel changes in science education (see "School Science is Changing: Implications for Further Education", SSCR and FEU).
 7. TVEI is a phased programme and many of these changes will not happen uniformly. FE institutions must seek to develop strategies of implementation to match the goals of the developing curriculum.

APPENDIX 1 The essential differences between the CDT courses (taken from the CDT subject-specific criteria)

CDT: Design and Realisation

Design and Realisation is principally concerned with design and problem-solving processes leading to the making and evaluation of artefacts. It draws upon imagination and an understanding of materials and technologies. It demands active workshop experience, and leads to the appreciation and production of work of quality.

CDT: Technology

Technology is principally concerned with design and problem-solving processes leading to the making and evaluation of artefacts and systems. It draws upon scientific principles. Technology also involves management of the environment and familiarity with the concepts of materials, energy and control.

CDT: Design and Communication

Design and Communication is concerned with the communication of ideas and information, and is a vehicle for the development of problem-solving activities. The methods and techniques employed will vary according to the requirements of those imparting and those receiving information. Design and Communication is concerned not only with detailed information relating to the production of an artefact, but also with such concepts as form, method, system, sequence, assembly, comparison, procedure and evaluation.

APPENDIX 2

SUBJECTS	TVEI STUDENTS						NON-TVEI STUDENTS					
	BOYS	% of Boys	GIRLS	% of Girls	ALL	% of All	BOYS	% of Boys	GIRLS	% of Girls	ALL	% of All
Technology	1386	14.3	355	4.4	1741	9.8	1438	5.5	272	1.0	1710	3.2
Miscular Technology	1354	14.0	279	3.4	1633	9.2	1140	4.3	144	0.5	1284	2.4
Electronics	1245	12.9	218	2.7	1463	8.2	1036	3.9	164	0.4	1140	2.1
Control Technology	291	3.0	36	0.4	327	1.8	391	1.5	49	0.2	440	0.8
Micro Electronics	216	2.2	64	0.8	280	1.6	77	0.3	29	0.1	106	0.2
Manufacturing Technology	151	1.6	33	0.4	184	1.0	54	0.2	18	0.1	72	0.1
New Technology	72	0.7	33	0.4	105	0.6	107	0.4	51	0.2	158	0.3
Robotics	93	1.0	0	0.0	93	0.5	26	0.1	2	0.0	28	0.1
Computer Studies and Technology	54	0.6	28	0.3	82	0.5	0	0.0	0	0.0	0	0.0
Engineering Technology	67	0.7	15	0.2	82	0.5	49	0.2	0	0.0	49	0.1
Engineering 685	68	0.7	11	0.1	79	0.4	74	0.3	7	0.0	81	0.2
Electrical and Electronic Instrumentation	57	0.6	14	0.2	71	0.4	111	0.4	14	0.1	125	0.2
Biotechnology	37	0.4	33	0.4	70	0.4	43	0.2	42	0.2	85	0.2
Creative Technology	26	0.3	25	0.3	51	0.3	0	0.0	0	0.0	0	0.0
Electronics Technology	48	0.5	2	0.0	50	0.3	4	0.0	0	0.0	4	0.0
Total Numbers for % calculation	9606		8112		17798		26387		27341		53728	

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 - Welsh Joint Education Committee
 - Midland Examining Group
 - Southern Examining Group
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For the purposes of this paper it has been necessary to draw on information from the following sources:-

- The Examination Groups,
- The Secondary Examinations Council (SEC), and
- The TVEI Curriculum Database at Trent Polytechnic (1982 - 1987).

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